eleven human skeletons with many ornaments, some of them in bronze, representing snakes, heads of various animals, &c.; and a comparison of the Ryazan skulls and ornaments with those excavated in the Moscow and Meriaks *koorganes*, proves that they belong to quite a different people. Altogether the discovery promises to be of great importance. Another gentleman sent by the same society, M. Bensengr is busily engaged in making anthropological measurements and ethnographical descriptions of the Ryazan Tartars.

AT the meeting of the St. Petersburg Society of Naturalists on December 9, M. Polyakoff—returned from a journey to Western Siberia, the Altai, and Alatan Mountains—read a report on the interesting question as to the state of Central Asia during the glacial period. After having described the boulder-clays, boulders, and morainic deposits he met with during his journey, as well as the present characters of the flora and fauna of the country, he concluded in favour of a complete glaciation of Central Asia during the last ice-period.

WE notice a valuable Russian work, just published by M. Mushketoff, "Materials for a Knowledge of the Geology and of the Mines of the Zlatoust Mine District in Southern Ural." It is the result of careful study, contains many new and valuable data, and is accompanied by an elaborate geological map.

AT the last meeting of the Russian Geographical Society on December 8, Prof. Ujfalvy, of the Paris High School of Eastern Languages, who was sent by the French Government on an anthropological mission to Central Asia, made a very interesting communication on his work in the Russian provinces of Orenburg, Fergana, and Turkistan. After a careful study of the Bashkirs, he arrived at the conclusion that this people are the original stock of the Madjars; that the Mescheryacks are intermediate between Bashkirs and Ostyacks, and that the Tepteri are true Tartars. The conclusions arrived at as to the various peoples of Turkistan are more complicated and could not be briefly stated; but the learned professor has collected many important data, and has obtained valuable photographs, collections of old coins from Turkistan, of stone implements from Siberia, &c.—At the same meeting M. Minaieff referred to the work he has compiled, by order of the society, on the tracts of Central Asia occupying the upper parts of the Amu-daria. The work is divided into three parts: geographical, ethnographical, and linguistic, the former being the richest, and sums up all we know at present about those lands.

COL. GORDON has lately entered into a contract with Messrs. Yarrow and Co., of Poplar, for four steel steamers of small draught. He intends exploring the Albert Nyanza and the rivers flowing into it. The steamers are to be carried as far as possible by water, and are to be composed of several portable pieces of about 200 lbs. each, to be put together on arrival at their destination. Col. Gordon and his party are reported to be in good health.

SINCE the beginning of last year a new scientific journal has appeared at Christiania (Cammermeyer) under the title *Archiv for Mathematik og Naturvidenskab*. It is edited by Herrer Sophus Lie, Jakob Worm Müller, and G. O. Sars. The journal is published in four yearly parts which form a volume of about 500 pages. We have received the first seven parts, and may congratulate the editors and publishers on the decided step of progress which the appearance of this journal evidently marks in the history of Norwegian science. Amongst a number of mathematical papers by Herr Sophus Lie, and others of minor interest, there are some interesting geological treatises by Herr Karl Pettersen, viz., on the orography of Norway, on the geology of the Salten fjord, on the giant's cave near the Lavangen fjord in the neighbourhood of Sandvort, and on the fjords of Northern Norway. Herr S. A. Sexe has contributed two papers on some old coast-lines and on the direction of the winds in the so-called "stille Belt." Herr Amund Helland is the author of a treatise on the ice-filled fjords of Northern Greenland, and of an elaborate account of the varying quantities of chlorine present in the sea-water of the German Ocean, the Atlantic, and Davis' Straits. Herr G. O. Sars contributes an interesting note on the scientific expeditions in the Atlantic during 1876, and some detailed researches on the invertebrate fauna of the Mediterranean (with plates.) Herr J. Worm Müller gives some notes on Malassez's method of estimating the number of red corpuscles in blood as well as on the relation between the number of red corpuscles and the colouring power of blood. Of the remaining papers we note—a metallurgical paper by E. Münster; on the influence of the eccentricity of the orbits of heavenly bodies upon the quantity of heat they receive from the sun, by H. Geelmuyden; and two zoological notes, one by J. Koren and D. C. Danielssen, the other by Herman Friele.

THE additions to the Zoological Society's Gardens during the past week include a Greater Sulphur-Crested Cockatoo (*Cacatua galerita*) from Australia, presented by Miss Rosetta Cohen; a Grey-breasted Parrakeet (*Bolborhynchus monachus*) from Monte Video, presented by Mr. Alex. F. Baillie; a Mocassin Snake (*Tropidonotus fasciatus*), born in the Gardens.

CERTAIN MOVEMENTS OF RADIOMETERS[1]

NEARLY two years ago Mr. Crookes was so good as to present me with two of his beautiful radiometers of different constructions, the discs of one being made of pith, and those of the other of roasted mica, in each case blackened with lampblack on one face. With these I was enabled to make some experiments, having relation to their apparently anomalous movements under certain circumstances, which were very interesting to myself, although the facts are only such as have already presented themselves to Mr. Crookes, either in the actual form in which I witnessed them, or in one closely analogous, and have mostly been described by him. Although it will be necessary for me to describe the actual experiments, which have all been repeated over and over again so as to make sure of the results, I do not bring forward the facts as new. My object is rather to endeavour to co-ordinate them, and point to the conclusions to which they appear to lead.

I do not pretend that these conclusions are established; I am well aware that they need to be further confronted with observation; but as I have not leisure to engage in a series of experiments which would demand the expenditure of a good deal of time, and have lately been urged by a friend to publish my views, I venture to lay them before the Royal Society, in hopes that they may be of some use, even if only in the way of stimulating inquiry.

In describing my experiments I will designate that direction of rotation in which the white face precedes as positive, and the reverse as negative. It will be remembered that, under ordinary circumstances, radiation towards either radiometer produces positive rotation.

1. If a glass tumbler be heated to the temperature of boiling water, and inverted over the mica radiometer, there is little or no *immediate* motion of the fly, but quickly a *negative* rotation sets in, feeble at first, but rapidly becoming lively, and presently dying away.

2. If after the fly has come to rest the hot tumbler be removed, a *positive* rotation soon sets in, which becomes pretty lively[2] and then gradually dies away as the apparatus cools.

3. If the tumbler be heated to a somewhat higher temperature, on first inverting it over the radiometer there is a *slight positive* rotation, commencing with the promptitude usual in the case of a feeble luminous radiation, but quickly succeeded by the negative rotation already described. If the tumbler be heated still more highly, the initial positive rotation is stronger, and lasts longer, and the subsequent negative rotation is tardy and feeble.

4. If the pith radiometer be treated as in § 1, the result is the same, with the remarkable difference that the rotation is positive instead of negative; it is also less lively.

[1] Paper read at the Royal Society, December 20, by Prof. G. G. Stokes, Sec. R.S.

5. But if the tumbler be removed when the fly has come to rest, it remains at rest, or nearly so.

6. If the tumbler be more strongly heated, positive rotation begins as promptly as with light. In this case the tumbler must not be left long over the radiometer, for fear the vacuum should be spoiled by the evolution of gas from the pith.

7. If the tumbler be heated by holding it over the spout of a kettle from which steam is issuing, and held there till the condensation of water has approximately ceased, and be then inverted over the pith radiometer, the bulb is immediately bedewed, and a *negative* rotation is almost immediately set up, though sometimes, just at the very first moment, there is a trace of positive rotation. The negative rotation is lively, but not lasting; and after fifteen seconds or so, is exchanged for a positive rotation, which is not lively, but lasts longer.

8. If the tumbler be lifted when the negative rotation has ceased, and the dewed surface be strongly blown upon, a lively but brief positive rotation is set up.

9. To produce positive rotation by blowing it is not *essential* that the bulb be wet. If it be merely warm, and the circumstances are such that the fly is at rest for the moment, or nearly so, blowing produces positive rotation, though much less strongly than when the bulb is wet.

10. If the tumbler be heated as in § 7, and inverted over the mica radiometer, the rotation is positive, as when the tumbler is dry.

11. If the tumbler or a cup be smoked inside (to facilitate radiation), heated to a little beyond the temperature of boiling water, and inverted over the pith radiometer, a positive rotation is produced; and if, when this has ceased, which takes place in a couple of minutes or so, the heated vessel be removed, a negative, though not lively, rotation is produced as the apparatus cools.

12. These results do not seem difficult to co-ordinate so far as to reduce them to their proximate cause.

As regards the small quantity, if any, of heat radiated directly across the glass of the bulb, the action of which was experimentally distinguishable by its promptitude, both radiometers behaved in the ordinary way.

13. As regards the mica radiometer, when the bulb gets heated and radiates towards the fly the fly is impelled in the negative direction *as if* the white pearly mica were black and the lampblack were white. And there is nothing opposed to what we know in supposing that such is *really* their relative order of darkness as regards the heat of low refrangibility absorbed and radiated by the glass; for the researches of Melloni and others have shown that lampblack is, if not absolutely white, at any rate very far from black as regards heat of low refrangibility. On the other hand, glass and mica are both silicates, not so very dissimilar in chemical composition, and it would not therefore be very wonderful, but rather the reverse, if there were a general similarity in their mode of absorption of radiant heat, so that the heat most freely radiated by glass and accordingly abounding in the radiation from *thin* glass such as that of the bulb, were greedily absorbed by mica. The explanation of the reversal of the action when heat and cold were interchanged is too well known to require mention.

14. With the pith radiometer, when the bulb as a whole is heated, and radiates towards the fly, the impulse is positive, though less strong than in the case of the mica (§ 4); and when the bulb as a whole is cooler than the fly the impulse is negative (§ 11).

But to explain all the phenomena we must dissect the total radiation from or towards the bulb. When I first noticed the negative rotation produced by a heated wet tumbler, I was disposed to attribute it to radiation from the water, which possibly the glass of the bulb might be thin enough to let pass; but when I found that hot water in a glass vessel outside, even though the glass of it were thin, produced no sensible effect, and that blowing on the heated bulb when it was dry produced a similar effect to blowing on it when dewed, though of much less amount, I perceived that the moisture acted, not by direct radiation from it, and in consequence of a difference of quality between the radiations from glass and water, but by causing a rapid *superficial* heating of the bulb; and, similarly, the blowing on the dewed surface acted by causing a rapid superficial cooling. When the dry tumbler radiates to the bulb, the radiation is absorbed at various depths; the absorption is most copious, it is true, at the outer strata, but still the change of temperature is not by any means so much confined to the immediate surface as when we have to deal with the latent heat of vapour condensed on it, or obtained from it by rapid evaporation.

Hence, thin as is the glass of the bulb (about 0·02 in. thick), we must still, in imagination, divide it into an outer and inner stratum, and examine the effects of these separately. The heat radiated by either stratum depends only on its temperature, but the radiation from the outer, on its way to the fly, is sifted by passing through the inner, and the portion for which glass is most excessively opaque is in great part stopped. It appears from the observed results that the residue acts decidedly negatively, while when the bulb is pretty uniformly heated there is positive action. We may infer that if it were possible to heat the inner stratum alone it would manifest a very decided positive action.

15. In the struggle between the opposing actions of the outer and inner strata we see the explanation of the strange behaviour of the pith radiometer. In the experiment of § 7 the outer stratum at first shows its negative action, but quickly the inner also gets heated, partly by conduction from the outer, partly by direct radiation from the tumbler, and then the inner prevails. In the experiment of § 5 the whole bulb cools, partly by radiation, partly by convection, while the fly remains warmer; and the slightly greater coolness of the outer than of the inner stratum makes up for the superiority of the inner when the two are equally cool, so that the antagonistic actions nearly balance, and slight causes, such as greater or less agitation of the air, suffice to make the balance incline one way or other. That the inner stratum *would* prevail if the two were about equally cooled may be inferred from the behaviour of the radiometer when the bulb is pretty uniformly heated (§§ 4, 11), or shown more directly by cooling the bulb with snow, when a negative rotation may be obtained.

16. The complete definition of a radiation would involve the expression of the intensity of each component of it as a function of some quantity serving to define the quality of the component, such as its refractive index in a standard medium, or its wave-length, or the squared reciprocal of the wave-length.[1] The experimental determination of the character, as thus defined, of a radiation consisting of invisible heat-rays is beset with difficulties, at least in the case of heat of extremely low refrangibility; and in general we can do little more than speak in a rough way of the radiation as being of such or such a kind. It is obvious that the behaviour of radiometers by itself alone affords no indication of the refrangibilities of the kinds of heat with which we have to deal; nevertheless, by combining what we know of the behaviour of bodies in respect to radiations in general (especially luminous radiations, which are the most easily studied) with what we observe as to the motions of radiometers, we may arrive at some probable conclusions.

17. We may evidently *conceive* a series of ethereal vibrations of any periodic time, however great, to be incident on a homogeneous medium such as glass, and inquire in what manner the rate of absorption would change with the period; though whether we can actually *produce* ethereal vibrations of a very long period is another question, seeing that we can only act on the ether by the intervention of matter, and are limited to such periods of vibration as matter can assume when vibrating molecularly, in a manner communicable to the ether, and not as a continuous mass, in the manner of the vibrations which produce sound. We may inquire whether, on continually increasing the period of vibration, the glass (or other medium) would ultimately become and remain very opaque, or whether, after passing through a range of opacity, it would become transparent again, on still further increasing the period of the incident vibrations.

18. This is a question the experimental answer to which, as it seems to me, could only be given, in so far as it could be given at all, as a result of a long series of experiments, of a kind that Melloni has barely touched on. A variety of considerations, which I could not explain in short compass, lead me to regard the second alternative as the more probable, namely, that, on increasing the periodic time, homogeneous substances in general (perhaps even metals, though this is doubtful) become at last transparent, or at least comparatively so. The limit of opacity, in all probability, varies from one substance to another; and the lower it is, the lower would be the lowest refrangibility of the radiation which the same substance is capable of emitting.

19. In what immediately follows I shall suppose accordingly that glass is strongly absorbing through a certain range of low

[1] A map of the spectrum, constructed with the squared reciprocals of the wave-lengths for abscissæ, would be referred to a natural standard, no less than that of Angström, which is constructed according to wave-lengths; while it would have the great advantage of admitting of ready comparison with refraction spectra, the kind almost always used.

refrangibility, on *both* sides of which it gradually becomes transparent again.[1] Imagine a spectrum containing radiations of all refrangibilities with which we have to deal; let portions of this spectrum on the two sides of the region of powerful absorption for glass be called *wings* of that region, and let left to right be the order of increasing refrangibility. Then the spectrum of the radiation from a thin plate of glass, if it could be observed, would be seen to occupy the region of chief absorbing (and therefore emitting) power and its wings. The spectrum of the radiation from the outer stratum of the bulb of the pith radiometer, after transmission through the inner, would consist of two wings, with a blank, or nearly blank, space between; it would resemble, in fact, a widened bright spectral line, with a dark band of reversal in its middle, save that, instead of being confined to extremely narrow limits of refrangibility, the central space and its wings would be of wide extent. It follows from the experiments that, in the complete radiation from glass, the portions of the spectrum called the wings together act negatively, the portion between positively. It does not, of course, follow that each wing acts negatively, but only that the balance of the two is negative. When the tumbler is heated a little over 212° there is a slight positive action from radiation which passes directly through the bulb. The circumstances lead us to regard this as an extension of the right wing; for it comes from a depth, measured from the inner surface of the bulb in glass, *i.e.*, not counting the intervening air, somewhat greater than the thickness of the wall of the bulb; and we know that the more a solid body is heated, the higher, as a rule, does the refrangibility of the radiation which it emits extend, and the greater the proportion of rays of high to those of low refrangibility. It is simplest, therefore, to suppose that the action of the right wing, like that of the space between the wings, is positive, and that the observed negative action in the experiment of § 7 is due to the excess of negative action of the left wing over positive action of the right. In the mica radiometer the experiments indicate no such difference of action in the different layers of the bulb as in the case of the pith radiometer. Hence taking, in accordance with what now appears to be made out to be the theory of the motion of the radiometer, the direction in which the fly is impelled as an indication which is the warmer of the two faces of the discs, and that again as an indication which is the darker with respect to the radiation to which it is exposed, we arrive at the following results as regards the order of darkness of the substances for the three regions into which the spectrum of the incident radiation has been supposed to be divided, the name of the lighter substance being in each case placed above that of the darker:—

	Left wing.	Region of intense absorption by glass.	Right wing.
From pith radiometer ...	Lampblack.	Pith.	Pith.
	Pith.	Lampblack.	Lampblack.
From mica radiometer ...	Lampblack.	Lampblack.	Mica.
	Mica.	Mica.	Lampblack.

Hence, on descending in refrangibility, the order of darkness of the two substances o either pair is at first the same as for the visible spectrum, and at last the opposite; and the reversal of the order takes place sooner with mica and lampblack than with pith and lampblack. The order falls in very well with that of the chemical complexity of the three substances.

20. The whole subject of the behaviour of bodies with respect to radiant heat of the lowest degrees of refrangibility seems to me to need a thorough experimental investigation. The investigation, however, is one involving considerable difficulty. We can do little towards classifying the rays with which we are working unless we can form a pure spectrum. A refraction spectrum is the most convenient; but the only substance known which would be approximately suitable for forming the prism, lens, &c., required for such a spectrum, and for confining liquids, is rock-salt, of which it is extremely difficult to procure perfectly limpid specimens of any size; and even rock-salt itself, as Prof. Balfour Stewart has shown, is defective in transparency for certain kinds of radiant heat. Then, again, the only suitable measuring-instrument for such researches, the thermopile, demands a thorough examination with reference to the coating to be employed for absorbing the incident radiation. Hitherto lampblack has been used almost exclusively for the purpose; and it is commonly assumed, in accordance with certain of Melloni's results, that lamplack absorbs equally heat-rays of all kinds. But the experiments by which Melloni established the partial diathermancy of lampblack prove that rays exist for the absorption of which that substance is unsuitable.

On calling on Mr. Crookes after the above was written, I was surprised to find that all his mica radiometers behaved towards a heated glass shade in the opposite way to that he had given me, going round positively instead of negatively. Mr. Crookes showed me and gave me a specimen of the kind of mica he employs as eminently convenient for manipulation. It is found naturally in a condition resembling artificially roasted mica. It is not, however, quite so opaque for transmitted light, nor of quite such a pearly whiteness for reflected light as that which has been artificially roasted at a high temperature. The mica radiometer that Mr. Crookes first gave me, which I will call M_1, was, Mr. Gimingham told me, the only one they had made with roasted mica.

Mr. Crookes was so kind as to give me, for comparative experiment, a mica radiometer, which I will call M_2, made from the natural foliated mica. It revolves a good deal more quickly than M_1 under the influence of light; it also gets more quickly under way, indicating that the mica is thinner. When covered with a hot glass it revolves positively, as already remarked; there is, however, but little negative rotation when the glass is removed.

The difference in the thickness and condition of the mica sufficiently explains the difference of behaviour of M_1 and M_2. Any radiant heat incident on the white face that reaches the middle of the mica, whether it afterwards is absorbed by the mica or reaches and is absorbed by the lampblack, tends to heat the second or blackened face more than the first, and therefore conspires with the heat incident on the lampblack, and absorbed by it, to produce positive rotation; and the smaller thickness and less fine foliation of the natural mica are favourable to the transmission of radiant heat to such a depth.

P.S.—It might be supposed at first sight that the change of rotation from negative to positive (in § 7) was due, not to a change in the conditions of absorption, but to the circumstance that the inner surface of the bulb had become warm by conduction, so as to be warmer than the surfaces of the fly instead of colder. For we now know that the "repulsion resulting from radiation," as in some way or other it undoubtedly does result, is an indirect effect, in which radiation acts only through the alterations it occasions in the superficial temperatures of the solids in contact with the rarefied gas; and it might be supposed that when the inner surface of the bulb passed from colder than the fly to warmer, the direction of rotation would, on that account alone, be reversed. This, however, is not so. If bulb and fly are at a common temperature, and the instrument is protected from radiation, the fly remains at rest whether the common temperature be high or low. If a small portion of the total surface in contact with the rarefied gas be warmed by any means, repulsion takes place, through the intervention of the rarefied gas, between the warmed surface and the opposed surfaces, if not too distant; if it be cooled, the result is attraction. It does not matter whether the surface at the exceptional temperature belong to the fly or the bulb. The former takes place in the ordinary case of a radiometer exposed to radiation, the latter in that of a radiometer at a uniform temperature and protected from radiation when a small portion of the bulb is warmed or cooled, in which case the part at the exceptional temperature repels or attracts the disc irrespectively of its colour or the nature of its coating.[1] Suppose now that the fly is being warmed by radiation from without, the bulb being cool, at least at its inner surface. Let A, B be the two kinds of faces of the discs, and suppose A to be the better absorber of the total radiation. Then A will be the warmer, and therefore will be more strongly repelled than B. Suppose now that the bulb is heated till its inner surface becomes warmer than the fly. Then the fly will still be receiving heat by radiation, to some extent also by communication from the gas; but this will be the same for both faces. Hence if A be still the better absorber of the two (A, B), A will be the warmer, and being less below the tem-

[1] It may be noticed that this supposition, which, as appearing the more probable, is adopted for clearness of conception, is not essentially involved in the explanation that follows, which would hardly be changed if the "left wing" were not terminated on the left.

[1] Theoretically there would be a minute difference of temperature, produced, other circumstances being alike, by the difference in the absorbing or emitting power of the two faces of a disc, as regards the radiation which is the difference between the radiations from or towards the affected portion of the bulb and the same portion at the normal temperature. But this, and the repulsion or attraction corresponding to it, would be only a small quantity of the second order, the main effect being deemed one of the first order.

perature of the interior surface of the fly will be less attracted, or, which is the same, more repelled. Hence, whether the inner surface of the bulb be cooler or hotter than the fly, a reversal in the direction of rotation while the fly is being heated, indicates a reversal in the order of absorbing power of the two faces, and that, again, shows that the order is different for different components of the total radiation, and that the ratio of the intensity of those components has been changed.

It is perhaps hardly necessary to observe that the radiometers mentioned in this paper are of the usual form—that is to say, that their arms are symmetrical, so far as *figure* is concerned, with respect to a vertical plane passing through the point of support. Accordingly the rotation which is attained, for instance, with a radiometer with concave disks of aluminium, alike as to material on both faces (of which kind, again, I owe a beautiful specimen to Mr. Crookes's kindness), has not been referred to. This rotation, depending on the more favourable presentation to the bulb of the outer (and therefore nearer and more efficient) portions of the fly on the convex than on the concave side, has nothing to do with the one isolated subject to which the present paper relates, namely, the elucidation of the peculiar behaviour in certain cases of certain kinds of radiometers, by a consideration of the heterogeneous character of the total heat-radiation.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

LEEDS.—By the liberality of the Worshipful the Drapers' Company, the Council of the Yorkshire College are prepared to appoint an instructor in coal mining at the stipend of 100*l.* per annum and half the students' fees. A portion only of the instructor's time will be required. The fuller conditions and duties of the office may be learned from the secretary. Applications and testimonials must be received on or before January 18.

LEXINGTON, U.S.—In connection with the Centennial, efforts have been made in the United States to raise an endowment fund for Washington and Lee University, at Lexington, Va. The institution dates from colonial times, and was endowed, while it was still only an academy, by Washington and other soldiers of the Revolution. Among other recent benefactors of the University is Mr. L. J. McCormick, of Chicago, who has offered to give his magnificent telescope, made by Alvan Clark, of Cambridge, U.S., at a cost of 50,000 dols., provided the institution would raise the necessary funds to equip and maintain it. The trustees have not yet been able to do anything towards the acceptance of this proposal. It would be a great misfortune if the conditions could not be complied with, and we hope that the suggestion that the ladies in various parts of the States should take the matter up will be complied with; there is no doubt if they make up their minds to success they will succeed.

BERLIN.—The great Prussian university is closely competing now with the Leipsic University in point of attendance. In the calendar which has just appeared we notice that the number of matriculated students during the present winter amounts to 2,839, an increase of 600 on the summer semester. They are divided among the faculties as follows: theological 168, legal 1,163, medical 345, philosophical 1,163. There are 210 foreigners in the list, including 42 from America. Besides these matriculated students, there are 2,200 other persons in attendance on the lectures, belonging to the various technical and art schools of the city. The corps of instructors numbers 210, nearly half of whom are in the philosophical faculty.

BONN.—The winter attendance at the University is 859, an increase of sixty-two on the preceding semester. The philosophical faculty includes 375, the legal 219, the medical 126, the Catholic theological, 89, and the Evangelical, 50.

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, December 6.—Prof. Allman, president, in the chair.—Messrs. J. N. Fitch, J. S. Gamble, F. S. Piggott, A. B. Stewart, and Prof. Macoun were elected Fellows.—Mr. Thiselton Dyer exhibited portions of the "Nam-mu" tree, which grows in Yunnan, 25°–26° N. lat. The Chinese nobility greatly prize its wood for building purposes and for making coffins, and enormous columns in tombs of the Ming dynasty, 300 years old, are still extant. Supposed to be teak, it probably rather belongs to the Lauraceæ, the leaves closely resembling those of *Phœbe pallida.* Mr. Dyer also exhibited a seed of *Entada scandens*, and another of an anonaceous plant (*Cyathocalyx Maingayi ?*) found in the cœcum of *Rhinoceros sumatrensis* from Chittagong, and dissected at the Zoological Gardens, Regent's Park; and he likewise showed fruits of *Oncocarpus vitiensis* from the crop of a fruit-pigeon (*Carpophaga latrans*).—Attention was afterwards called by Mr. Dyer to the fruit-head of an Indian *Pandanns* made into a brush, the fibrous tissue of the drupes forming the bristles, and this instrument was said to be used to scrape cloth, like our teazle (*Dipsacus*).—Flowers and foliage of Cinchona (*C. calisaya*, vars., *Josephiana* and *Anglica*) grown in the garden of Mr. J. Elliot, at Tottenham, were exhibited by that gentleman, whose researches among the quinine-bearing trees are already well known and appreciated.—Mr. Moggridge read a note on the occurrence at Wallis Down, a heath near Bournemouth, of *Dabeocia polifolia.*—A paper on certain organs of the Cidaridæ was communicated by Mr. Chas. Stewart, who illustrated, amongst others, the subjoined points of his recent investigations. Among the sea-urchins the families Diadematidæ, Echinometridæ, and Echinidæ, have long been known to possess external branchiæ; but the existence of such in the Cidaridæ has been denied by Müller, though insisted on by Alex. Agassiz. Mr. Stewart finds in *Dorocidaris papillata* five organs corresponding to branchiæ, but situated internally. The water bathing these interior gills finds ingress and egress by a crevice near the "compasses," the peculiar mechanism of the teeth and jaws producing the temporary opening in question. As respects the pedicellariæ of Cidaridæ, where the jaw ends in a terminal hollow fang, there is an additional orifice to that at the tip, besides two glands in the vicinity; he suggests this to be a poison apparatus, comparable to the falces of the spider, and poison sac and tooth of venomous serpents.—The Secretary read a paper by Dr. I. Bayley Balfour, "Observations on the genus *Pandanus.*" Few families of plants present more difficulty in their elucidation than the Pandanaceæ; this by variability of species, difficulty of procuring the male flower, with little character in the leaves, while the fruit loses its distinctive features in drying. The Screw-pines had attracted the notice of the early voyagers, but their descriptions are confused. To Rumphius we owe the name Pandanus, though his account and figures are poor compared with Reede's of a century before. Linnæus, though indicating a plant under the name *Bromelia sylvestris*, omitted the genus *Pandanus*, a want supplied by his son. Afterwards, as species increased, many new genera were unnecessarily introduced, which Dr. Balfour is now inclined to reject; even Brongniart's New Caledonia genera do not claim acceptance. *Pandanus* runs over a great breadth of longitude, viz., from east tropical Africa through the Mascarene Islands, India, Indian Archipelago, and Australia, to the Sandwich Islands. The East Archipelago and the Mascarenes are centres whose species do not commingle. There succeeds in this paper other facts and an extensive list of names and references to all the Pandani known.—The substance was given of a report on a small collection of insects obtained by Dr. J. C. Ploëm, in Java, with description of a new species of *Hoplia*, by Chas. O. Waterhouse, of the British Museum.—The Secretary read a communication by Dr. J. Stirton, viz., "Notes on the Rev. Mr. Crombie's paper on the Lichens of the *Challenger* Expedition," and another note by Dr. R. C. A. Prior, relative to the migration of wild geese, purported to have passed from North America to the African coast.

Physical Society, December 15.—Prof. G. C. Foster, president, in the chair.—The following candidates were elected Members of the Society:—W. E. Ayrton, J. M. Cameron, J. W. Clark, J. E. Judson, B.A., H. N. Moseley, M.A., F.R.S., Lord Rayleigh, M.A., F.R.S., W. N. Stocker, M.A., and H. T. Wood.—Mr. C. W. Cooke read for the author, Prof. S. P. Thompson, a paper on permanent Plateau films, and exhibited the process of their formation. After a brief enumeration of the various attempts made by Plateau himself, Schwartz, Mach, Rottier, and others, most of which are described in the work of Plateau, the author described his own experiment on the subject. As the result of these he concludes that the best films are obtained by using a mixture of 46 per cent. of pure amber-coloured resin, and 54 of Canada balsam, which should be heated to from 93° to 95° C. The frames for forming the films are made of brass wire 0·3 mm. in diameter, and when thicker wire is employed they are found to be irregular in consequence of the retention of heat by the metal. The films are obtained by simply introducing these frames into the heated